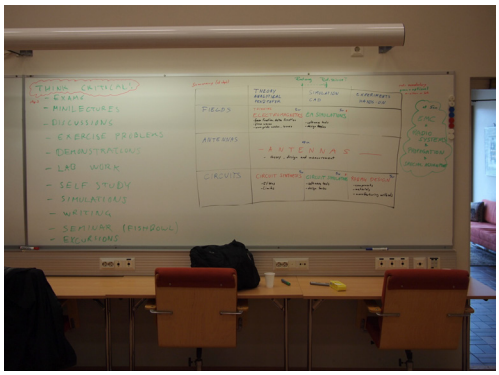
Department of Radio Science and Engineering

RAD Research and Education 2011

Jari J. Hänninen and Ari Sihvola (editors)



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Aalto University
School of Electrical Engineering
Department of Radio Science and Engineering

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Table of Contents

1. Introduction

The Department of Radio Science and Engineering (RAD) is a small but essential part of Aalto University, a new University formed in January 2010 as a merger of three universities: Helsinki University of Technology, Helsinki School of Economics, and the University of Art and Design in Helsinki. Located in Otaniemi, Espoo, the RAD department belonged in 2011 as one of the seven departments to the Aalto University School of Electrical Engineering. Until the end of 2010 the School of Electrical Engineering was known as the Faculty of Electronics, Communications and Automation within the Aalto University School of Science and Technology, which was the successor of the century-old Helsinki University of Technology (TKK). The history of TKK could be traced back to mid-19th century when it was founded as the rather modest Helsinki Technical School. The institution was granted university status in 1908 by Emperor Nicholas II who was the Grand Duke of Finland until his abdication in 1917.

The RAD Department in the Otaniemi campus of Aalto University is presently within the School of Electrical Engineering.

In this report, which describes the activities of the Department of Radio Science and Engineering, the following abbreviations occur often:

- Aalto ELEC: Aalto University School of Electrical Engineering (in Finnish: Aalto-yliopiston sähkötekniikan korkeakoulu)
- RAD: Department of Radio Science and Engineering (radiotieteen ja -tekniikan laitos)
- TKK: Helsinki University of Technology (Teknillinen korkeakoulu) (historical abbreviation)
- SMARAD: Centre of Excellence in Smart Radios and Wireless Research
- GETA: The Finnish Graduate School in Electronics, Telecommunications, and Automation
- IEEE: Institute of Electrical and Electronics Engineers
- URSI: International Union of Radio Science (in French: Union Radio-Scientifique Internationale)
- SA: Academy of Finland (in Finnish: Suomen Akatemia)
- EU: European Union (Euroopan unioni)
- ESA: European Space Agency (Euroopan avaruusjärjestö)
- VTT: VTT Technical Research Centre of Finland (Teknologian tutkimuskeskus VTT)

2. Finances

The total budget of the Department of Radio Science and Engineering was 6 059 000 € (in 2010, the corresponding figure was 6 696 800 €). From this amount, the funding through the university budget (including special funding for SMARAD) was 3 235 000 € (2 772 800 €), which is 53 % (34%) of the total. Most of the researchers and students working in the RAD Department were paid from project funding, which amounted to 2 670 000 € (3 924 000 €), meaning 44 % (66%) of the total expenses. Other income was worth 154 000 €.

Project funding from external sources in 2011 and 2010 for research was as follows (in euros):

	2011	2010
Academy of Finland (SA)	1 126 000	1 340 000
Technology Development Center (TEKES)	555 000	732 000
EU	312 000	466 000
ESA and other international partners	153 000	600 000
Finnish industry and other domestic funding	524 000	606 000
TOTAL	**2 670 000**	**3 924 000**

3. Research Teams in the RAD Department

For administrative purposes, it is helpful to divide the research personnel in the RAD department into the following groups, even if the division is artificial in some respects. Interaction between the teams is strongly encouraged and several co-operation efforts are ongoing.

- **Millimeter Wave Techniques.** The research group is led by Prof. Antti Räisänen. There are 3 other scientists with a doctoral degree (Juha Mallat, Juha Ala-Laurinaho, and Dmitri Lioubtchenko) and researchers working towards their doctoral degree. In addition, Professor Constantin Simovski works half-time in this group.
- **Advanced Artificial Materials and Smart Structures.** This research group is led by Prof. Sergei Tretyakov. The research group includes 5 other scientists with a doctoral degree (Igor Nefedov, Constantinos Valagiannopoulos, Vladimir Podlozny, Olli Luukkonen, and Pekka Alitalo), and researchers working towards their doctoral degree. In addition, Professor Constantin Simovski works half-time in this group.
- **RF Applications in Mobile Communications and Non-Destructive Testing.** This research group is led by Prof. Pertti Vainikainen. There are 7 other scientists with a doctoral degree (Clemens Icheln, Tommi Laitinen, Outi Kivekäs, Katsuyuki Haneda, Jari Holopainen, Veli-Matti Kolmonen, and Valeri Mikhnev) and researchers working towards their doctoral degree.
- **Wave–Material Interaction.** The research group is led by Professor Ari Sihvola. The group contains 5 other scientists with a doctoral degree (Professor Emeritus Ismo Lindell, Johanna Leppävirta, Henrik Kettunen, Jiaran Qi, and Henrik Wallén), and researchers working towards their doctoral degree.
- **Computational Electromagnetics.** The group is led by Professor Keijo Nikoskinen. The group contains 7 other scientists with a doctoral degree (Tero Uusitupa, Sami Ilvonen, Jari Hänninen, Ilkka Laakso, Pasi Ylä-Oijala, Seppo Järvenpää, and Matti Taskinen), and researchers working towards their doctoral degree.
- **Space Technology.** The research group is led by Professor Martti Hallikainen. The group contains one other scientist with a doctoral degree (Sampsa Koponen), and researchers working towards their doctoral degree.
- **Circuit Theory, Simulation, and Modeling.** The research group is led by Prof. Martti Valtonen. There are 2 other scientists with a doctoral degree (Kimmo Silvonen and Timo Veijola) and researchers working towards their doctoral degree.

4. Personnel

The number of permanent, full-time employees in the Department of Radio Science and Engineering financed by the University budget was 23 on December 31, 2010. The total number of employees working in the Department of Radio Science and Engineering during the year 2011 was 128.

Ala-Laurinaho, Juha, D.Sc. (Tech.)	Senior scientist
Albooyeh, Mohammad, M.Sc.	Doctoral student from 9. 2.
Alitalo, Pekka, D.Sc. (Tech.)	Post-doctoral researcher
Allen, Mark, M.Sc. (Tech.)	Doctoral student until 31.10.
Bin Abdullah Al-Hadi, Azremi, M.Sc.	Doctoral student
Chicherin, Dmitry, Lic.Sc. (Tech.)	Doctoral student until 30.4.
Costa, Luis, Lic.Sc. (Tech.)	University teacher
Dahlberg, Krista, Lic.Sc. (Tech.).	Doctoral student
Du, Zhou, M.Sc.	Doctoral student
Enqvist, Anton, B.Sc. (Tech.)	Research assistant from 1.11.
Generalov, Andrey, M.Sc.	Doctoral student
Geng, Suiyan, Lic.Sc. (Tech.)	Doctoral student 1.9.-31.10.
Haapiainen-Laine, Sari, B.Sc.	Project secretary
Haimakainen, Johannes	Research assistant 1.6.-31.10.
Hakkarainen, Anssi, Mr.	Research assistant until 15.9.
Hallikainen, Martti, D.Sc. (Tech.)	Professor
Haneda, Katsuyuki, D.Sc.	Post-doctoral researcher
Holopainen, Jari, D.Sc. (Tech.)	University teacher
Honkala, Mikko, Lic.Sc. (Tech.)	Doctoral student
Hulkkonen, Mikko, Mr.	Research assistant
Hänninen, Jari, D.Sc. (Tech.)	Researcher
Icheln, Clemens, D.Sc. (Tech.)	Lecturer
Ilvonen, Janne, M.Sc. (Tech.)	Doctoral student
Ilvonen, Sami, D.Sc. (Tech.)	Post-doctoral researcher until 31.3.
Järveläinen, Jan, M.Sc. (Tech.)	Doctoral student
Järvenpää, Seppo, Ph.D.	Senior scientist
Kahra, Eino, Mr.	Laboratory technician
Kainulainen, Juha, M.Sc. (Tech.)	Doctoral student
Kanevska, Valentyna, M.Sc.	Project coordinator until 31.5.
Karilainen, Antti, M.Sc. (Tech.)	Doctoral student
Karttunen, Aki, Lic.Sc. (Tech.)	Doctoral student
Kataja, Juhani, M.Sc. (Tech.)	Doctoral student
Keltikangas, Kirsti, M.Sc. (Educ.)	Doctoral student
Kettunen, Henrik, D.Sc. (Tech.)	Post-doctoral researcher
Kestilä, Antti, M.Sc.	Doctoral student from 1.7.
Khanal, Subash, B.Sc.	Research assistant from 20.2.
Khatun, Afroza Mst, M.Sc.	Doctoral student
Kiminki, Sami, M.Sc. (Tech.)	Doctoral student
Kiuru, Tero, M.Sc. (Tech.)	Doctoral student until 27.11.
Kivekäs, Outi, D.Sc. (Tech.)	Post-doctoral researcher until 22.5.
Kivijärvi, Ville, Mr.	Research assistant from 1.6.
Kolmonen, Veli-Matti, D.Sc. (Tech.)	Post-doctoral researcher
Kyrö, Mikko, Lic.Sc. (Tech.)	Doctoral student
Laakso, Ilkka, D. Sc. (Tech.)	Post-doctoral researcher until 24.3.
Laakso, Lauri, Mr.	Laboratory technician
Laitinen Tommi, D.Sc. (Tech.)	Senior scientist
Lehtovuori, Anu, Lic.Sc. (Tech.)	University teacher
Leppävirta, Johanna, D.Sc. (Educ.)	Post-doctoral researcher, on leave of absence until 30.6.
von Lerber, Annakaisa, M.Sc. (Tech.)	Doctoral student
Lesnyak, Natalia, M.Sc.	Project secretary until 31.5., on leave of absence
Lindberg, Stina, B.Sc. (Econ.)	HR Secretary
Lioubtchenko, Dmitri, Ph.D.	Docent, Academy research fellow
Luukkonen, Olli, D.Sc. (Tech.)	Post-doctoral researcher until 31.5.
Maksimovitch, Yelena, Dr.	Researcher 16.6.-22.7. and 24.11.-22.12.
Mallat, Juha, D.Sc. (Tech.)	Senior university lecturer

Mancel, Caroline, B.Sc.	Research assistant 5.4. -16.10.
Markkanen, Johannes, M.Sc.(Tech.)	Doctoral student
Meriläinen Mikko, Mr.	Research assistant 13.1.-31.5.
Miettinen, Pekka, M.Sc. (Tech.)	Doctoral student, on leave of absence until31.10.
Mikhnev, Valeri, Dr.	Doctoral researcher from 13.6.
Molina Hurtado, Daniel, B.Sc.	Research assistant from 1.10.
Morits, Dmitry, M.Sc.	Doctoral student
Mylläri, Tuula, Ms.	Secretary
Muttilainen, Anna, B.Sc.(Tech.).	Research assistant until 31.5.
Mäkelä, Sampo, Mr.	Research assistant from 1.6.
Nagy, Sorana, M.Sc. (Econ.)	Project secretary until 30.4.
Nefedov, Igor, Dr.Sc.	Senior scientist
Niemi, Teemu, Mr.	Research assistant
Nieminen, Markku, M.Sc. (Tech.)	Controller
Nikoskinen, Keijo, D.Sc. (Tech.)	Professor, Deputy Head of the department until 31.7., Deputy Dean from 1.8.
Nykänen, Katrina, Ms.	Secretary until 30.4.
Olkkonen, Martta-Kaisa, M.Sc. (Tech.)	Doctoral student
Parveg, Dristy, M.Sc.	Doctoral student
Planman, Irma, Ms.	HR Secretary
Pousi, Patrik, D.Sc. (Tech.)	Doctoral student until 30.6.
Podlozny, Vladimir, Ph.D.	Project manager and senior scientist
Popovic, Delia, Ms.	Project secretary from 1.8.
Poutanen, Juho, M.Sc. (Tech.)	Doctoral student until 16.1.
Praks, Jaan, M.Sc.	University teacher
Qi, Jiaran, D.Sc. (Tech.)	Post-doctoral researcher
Rasilainen, Kimmo, Mr.	Research assistant
Rimpiläinen, Tommi, M.Sc. (Tech.)	Doctoral student
Robertson, Jean-Baptiste, M.Sc.Eng	Project coordinator until 31.3.
Rouhe, Erkka, Mr.	Process engineer
Rummukainen, Pekka, Mr.	Laboratory technician
Räisänen, Antti, D.Sc. (Tech.)	Professor, Head of the department
Schmuckli, Lorenz, Mr.	Laboratory technician
Seppänen, Jaakko, M.Sc. (Tech.)	Doctoral student
Sievinen, Pauli, Mr.	Research assistant until 2.9.
Sibakov, Viktor, M.Sc. (Tech.)	Laboratory manager
Sihvola, Ari, D.Sc. (Tech.)	Professor, Deputy Head of the department from 1.8.
Silvonen, Kimmo, D.Sc. (Tech.)	Senior lecturer
Simovski, Constantin, Dr.Sc.	Visiting professor
Song, Jinsong, B.Sc.	Research assistant from 24.1.
Tamminen, Aleksi, Lic.Sc. (Tech.)	Doctoral student
Takizawa, Kenichi, Dr.	Visiting researcher from 17.8. (-31.7.12)
Taskinen, Matti, D.Sc. (Tech.)	Senior scientist
Tikka, Tuomas, B.Sc. (Tech.)	Research assistant from 1.6.
Tretyakov, Sergei, Dr.Sc.	Professor
Uusitupa, Tero, D.Sc. (Tech.)	Post-doctoral researcher
Vaaja, Matti, M.Sc. (Tech.)	Doctoral student
Valagiannopoulos, Constantinos Dr.	Post-doctoral researcher
Valkonen, Risto, M.Sc. (Tech.)	Doctoral student
Vainikainen, Pertti, D.Sc. (Tech.)	Professor
Wallén, Henrik, D.Sc. (Tech.)	Post-doctoral researcher, university teacher
Valtonen, Martti, D.Sc. (Tech.)	Professor
Vehmas, Joni, Mr.	Research assistant
Veijola, Timo, D.Sc. (Tech.)	Laboratory manager
Virk, Usman, B.Sc.	Research assistant from 1.2.
Virtanen, Jarmo, Lic.Sc. (Tech.)	Senior research scientist
Ylä-Oijala, Pasi, Ph.D.	Docent, senior scientist
Zvolenský, Tomás, M.Sc.	Doctoral student

Exchange students and summer trainees

Amin, Amee, B.Sc.	Research assistant 1.6.-31.8.
Enayati, Amin, M.Sc.	Stipendiate 1.2.-30.9.
Hashemi, Seyedmohammade	Stipendiate from 17.10.

Hernandez Zamora, Bruno	Erasmus stipendiate from 17.10. (until 31.5.12)
Kari, Henri, Mr.	Research assistant 1.6.-31.8.
Kivijärvi, Ville, Mr.	Research assistant 1.6.-31.8.
Leinonen, Tuomas, Mr.	Research assistant 1.6.-31.8.
Liberal, Inigo, M.Sc.	Stipendiate 2.2.-31.5.
Medina Acosto, Gerardo, B.Sc.	Erasmus stipendiate until 19.1.
Näsilä, Antti, Mr.	Research assistant 1.6.-18.8.
Modrzewski, Rafal, Mr.	Research assistant 1.6.-31.8.
Ermolov, Kirill, Mr.	Research assistant 1.6.-31.8.
Huang, Yi, B.Sc.	Research assistant 1.6.-31.8.
Parkkila, Mikko, Mr.	Research assistant 6.6.-4.9.
Saponaro, Giulia, B.Sc.	Erasmus stipendiate 1.2.-31.7.
Salo, Sampo	Research assistant 1.6.-31.8..

Docents and Emeritus professors

Alanen, Esko, D.Sc. (Tech.)	Electromagnetics. Affiliated with the University of Kuopio
Kettunen, Lauri, D.Sc. (Tech.)	Computational electromagnetics. Professor, Tampere University of Technology
Lehto, Arto, D.Sc. (Tech.)	Radio engineering
Lindell, Ismo, D.Sc. (Tech.)	Professor emeritus
Luukanen, Arttu, D.Sc. (Tech.)	THz technology. Research professor, Director of MilliLab, VTT
Oksanen, Markku, D.Sc. (Tech.)	Electromagnetics. Affiliated with Pöyry Group
Pulliainen, Jouni, D.Sc. (Tech.)	Remote sensing. Professor, Finnish Meteorological Institute
Rahola, Jussi, D.Sc. (Tech.)	Computational Electromagnetics. Affiliated with Optenni
Salonen, Erkki, D.Sc. (Tech.)	Radio engineering. Affiliated with University of Oulu
Somervuo, Pekka, D.Sc. (Tech.)	Radio engineering. Affiliated with Nokia
Tiuri, Martti, D.Sc. (Tech.)	Professor emeritus
Tolmunen, Timo, D.Sc. (Tech.)	Radio engineering. Affiliated with Turku Polytechnic
Tornikoski, Merja, D. Sc. (Tech.)	Radio astronomy. Director of Metsähovi Radio Observatory
Tuovinen, Jussi, D.Sc. (Tech.)	Radio engineering.Research Professor, Vice President, VTT
Valtaoja, Esko, Ph.D.	Radio astronomy. Professor, University of Turku
Viikari, Ville, D.Sc. (Tech.)	Wireless sensors and antenna measurements. VTT
Viitanen, Ari, D.Sc. (Tech.)	Electromagnetics
Ylä-Oijala, Pasi, Ph.D.	Computational Electromagnetics

5. International Visits and Visitors

5.1 Short Visits by Foreign Scientists

- Dr. Tapan K. Sarkar, Syracuse University, USA, 2 weeks
- Dr. Magdalena Salazar Palma, Universidad Carlos III de Madrid, Spain, 2 weeks
- Dr., Ass. Prof. Takahiro Aoyagi, Tokyo Institute of Technology, Japan, 4 days
- D.Eng. Toru Taniguchi, Japan Radio, Co. Ltd., Japan, 1 day
- Ph.D. Yuri Kivshar, Australian National University, Canberra, Australia, 3 days
- Prof. Olga Glukhova, Saratov State University, Russia, 2 weeks
- Dr., Assoc. Prof. Sergey Pivnenko, DTU, 5 days
- Dr., Assoc. Prof. Manuel Sierra Castañer, UPM, 5 days
- Dr. Thomas Crowe, Virginia Diodes , 2 weeks

5.2 Extended Visits by Foreign Scientists

- B.Sc. Daniel Molina Hurtado, Universidad de Alicante, Spain, 3 months
- B.Sc. Giulia Saponaro, Universitá degli Studi di Pavia, Italy, 6 months

- Dr. Ignace Bogaert, University of Ghent, Belgium, 4 months
- B.Sc. Caroline Mancel, Chalmers University of Techonology, Sweden, 6 months
- B.Sc. Bruno Hernandez Zamora, Universidad Autonoma de Madrid, Spain, 4 months
- B.Eng. Soichi Saito, Tokyo Denki University, Japan, 2 months
- M.Eng. Daisuke Sugizaki, Tokyo Denki University, Japan, 1 month
- B.Eng. Kenshiro Tsutsuki, Tokyo Denki University, Japan, 1 month
- M.Sc. Seyedmohammad Hashemi, Iran University of Science and Technology, Iran, 3 months
- M.Sc. Amin Enayati, IMEC, Katholieke Universiteit Leuven, Belgium, 7 months
- Dr. Kenichi Takizawa, National Institute of Information and Communications Technology, Japan, 5 months
- M.Sc. Inigo Liberal, Public University of Navarra, 4 months

5.3 Visits in Foreign Institutes by RAD Scientists

- Ph.D. Pasi Ylä-Oijala, Ecole Polytechniques Federale de Lausanne (EPFL), Switzerland, 4 days
- D.Sc. (Tech.) Tero Uusitupa, Tokyo Institute of Technology, Japan, 2 weeks
- M.Sc. (Tech.) Juha Kainulainen, European Space Agency / European Space Astronomy Centre, Madrid, Spain, 3 weeks
- Dr. Igor Nefedov, Roma University La Sapienza, Roma, Italy, 2 days
- M.Sc. Tomás Zvolenský, Queen's University, Belfast, UK, 1 month
- D.Sc. (Tech.) Johanna Leppävirta, University of Auckland, New Zealand, 7 months
- D.Sc. (Tech.) Pekka Alitalo, German Aerospace Center, Wessling, Germany, 2 months
- Dr. Katsuyuki Haneda, University of Southern California, Los Angeles, CA., USA, 2 weeks
- Prof. Constantin Simovski, ITMO, St. Petersburg, 2 weeks
- Prof. Keijo Nikoskinen, D.Sc. (Tech.) Henrik Kettunen, Lic.Sc. (Tech.) Anu Lehtovuori, Harvard, MIT, Princeton, 1 week

6. Awards, Honors and Prizes

D.Sc. (Tech.) Kimmo Silvonen was awarded with the Teacher of the Year prize 2010 in the Aalto University Student Union (AYY) anniversary on 5 February 2011.

Envisioning the teaching of the future (this and cover photo by Juhani Kataja, used with permission).

7. Teaching

SPRING SEMESTER COURSES in 2011 (periods III and IV)

S-26.2300 Radio Frequency Measurements for 3rd year students (2 credits), J. Mallat and course assistants. Basics of radio-frequency measurements, laboratory experiments on impedance measurement, spectrum measurement, and RF device measurement.

S-26.2350 Parts of Radio Communications Systems for 4th year students (3 credits), C. Icheln, P. Vainikainen, T. Laitinen, and V.-M. Kolmonen. Structures of radio communications systems, transmitters, receivers, phase locking, noise, modulation, nonlinearities, link budget.

S-26.3000 Radio Engineering, special assignment for 4th year students or postgraduate students (3–8 credits), A. Räisänen, S. Tretyakov, P. Vainikainen, J. Mallat, and staff. Individual projects in connection with radio engineering research conducted in the Department of Radio Science and Engineering.

S-26.3060 Research Seminar on Radio Science and Engineering for all students but especially for 4th year and postgraduate students (1 credit), A. Räisänen and professors in the department. Weekly seminar lectures on research projects. Several visiting lectures from other research laboratories and institutes or from industry.

S-26.3100 RF and Microwave Engineering for 4th year students (5 credits), P. Vainikainen, J. Holopainen. Planar transmission lines, passive components, amplifiers, oscillators, mixers, integrated circuits, etc.

S-26.3120 Radio Engineering, laboratory course for 4th year students (7 credits), C. Icheln and course assistants. Microwave measurements: theory and equipment. Laboratory experiments on antenna measurements, GSM transmitter, and GSM receiver. In the spring semester: design, fabrication, and measurement of a transistor amplifier (continuation from autumn 2010).

S-26.3301 Radio Systems in Telecommunication I for 4th year students (3 credits), J. Putkonen and other adjunct teachers from industry. Technology of radio links and equipment.

S-26.3361 Millimetre Wave Engineering for 4th year students or postgraduate students (4 credits), C. Icheln. Millimetre wave components, transmitters, receivers, applications.

S-26.3392 Electromagnetic Compatibility for 4th year students or postgraduate students (4 credits), S. Tretyakov, P. Vainikainen, C. Icheln. Electromagnetic compatibility and testing.

S-26.3401 Antenna Techniques in Telecommunication for 4th year students or postgraduate students (4 credits), P. Vainikainen, C. Icheln, T. Laitinen, J. Holopainen. Antennas for fixed mobile and telecommunications applications.

S-26.4000 Postgraduate Course in Radio Science and Engineering (3–10 credits), annually varying topics. Spring term 2011: V. Chandrasekar, J. Praks, and A. Sihvola: Special topics in electromagnetics and radar signal processing. Joint course by Aalto University, Colorado State University, and Helsinki University with webcast lectures between the three campuses.

S-55.1100 Basics of Electrical and Electronics Engineering for 1st and 2nd year students (4 credits, not for electrical engineering students), K. Silvonen, L. Costa. Students learn the basics of electrical and electronics technology. Laboratory experiments.

S-55.1220 Circuit Analysis 2 for 1st year students (5 credits), M. Valtonen, A. Lehtovuori, assistants. Analyzing the transient behavior of circuits using the Laplace transform, concepts pertaining to system functions, and the operation of transmission-line circuits in both the time and the frequency domain, also the use of the Smith chart. This course is also taught using the Problem Based Learning (PBL) approach.

S-55.3110 Network Synthesis for 3rd year students (5 credits), A. Lehtovuori. Realizing driving point functions and transfer functions using both passive and active circuits, concept of a transmission zero, comparison of different filter realizations.

S-55.3210 Numerical Circuit Design Methods for 4th year and postgraduate students (5 credits), J. Virtanen, M. Honkala. Numerical methods used in circuit simulation and programming the numerical algorithms. Computer exercises.

S-92.3121 Satellite Communications (3 credits), J. Hänninen. Satellite communication systems, structure and operation of ground stations, influence of radiowave propagation phenomena on satellite communication.

S-92.3132 Remote Sensing (6 credits), M. Hallikainen. Active (radar, lidar) and passive (scanner, radiometer, spectrometer) remote sensing instruments and their applications. Remote sensing satellites and their orbits.

S-92.3146 Radio Astronomy (4 credits), M. Tornikoski. Fundamentals of astronomy and radio astronomy. Radio astronomy antennas and receivers, radiometers and observation methods. Radio emission by Sun, quasars and black holes. SETI. Recent results in radio astronomy.

S-92.3192 Special Assignment in Space Technology (5 credits), M. Hallikainen, J. Praks. An assignment on the development and use of space technology and its applications. The assignment may be a theoretical and/or experimental investigation, including a final report. The assignment may also be carried out by a group of students.

S-92.C "Star Works" (1-2 credits). An international workshop together with EESTEC: earth observation and space technology.

S-96.1121 Dynamic Field Theory for 2nd year students (5 credits), A. Sihvola and course assistants. Undergraduate level basic electromagnetics course required of most Aalto ELEC students, part 2.

S-96.3191 Special Project in Electromagnetics for 4th year students (3–5 credits), K. Nikoskinen, A. Sihvola. Research project on a chosen electromagnetic problem.

S-96.3180 Advanced Electromagnetic Simulations for 4th year students and postgraduate students (5 credits), J. Holopainen, P. Alitalo, A. Karilainen, J. Ilvonen, C. Icheln, S. Järvenpää, and M. Taskinen. Practical skills and knowledge of solving high frequency electromagnetic problems and designs using computer-aided software tools. The students will acquaint themselves with two software tools for computational electromagnetic simulation. A short theoretical background of each tool is taught. (2nd half of the course, the 1st half given in autumn 2010.)

S-96.3211 Waveguides and Resonators for 4th year students (5 credits), H. Wallén. Free and guided waves, waveguide and resonator structures.

S-96.3415 Antennas - Theory for 4th year students (5 credits), K. Nikoskinen and course assistants. Basic principles of electromagnetic radiation and analysis of antenna structures.

European School of Antennas short course (extracurricular): **Antenna measurements at millimetre and submillimetre wavelengths** for doctoral students (2–4 credits), A. Räisänen, visiting lecturers, and RAD staff. Introduction, mm- and sub-mm-wave instrumentation, near-field scanning, near-field to far-field transformation, compact antenna test range (CATR), CATR based on reflectors, a lens, or a hologram, site definition, construction of a hologram based CATR, quiet-zone testing and antenna testing in a CATR, antenna pattern correction techniques, future developments.

AUTUMN SEMESTER COURSES in 2011 (periods I and II)

S-26.1100 Orientation Course for Studies of Electronics and Electrical Engineering for 1st year students (1 credit), A. Räisänen and personnel of the School. General information of the university, studies, and motivation for the studies of mathematics, physics, computer science, etc.

S-26.2100 Foundations of Radio Engineering for 3rd year students (5 credits), A. Räisänen, J. Holopainen. Transmission lines and waveguides, basic microwave components and circuits, antennas, radio wave propagation, radio systems, applications.

S-26.2110 Fundamentals of Radio Engineering for master's program students (5 credits), A. Räisänen, J. Holopainen. Transmission lines and waveguides, basic microwave components and circuits, antennas, radio wave propagation, radio systems, applications.

S-26.2900 Elements of Electromagnetic Field Theory and Guided Waves for master programme students (8 credits), C. Simovski and a course assistant. Basics for electromagnetic field theory and guided waves. Maxwell's equations, material equations, boundary conditions, etc. Ohm's law, Kirchhoff's law, phasors, Poynting theorem, Smith chart, plane waves, waves in waveguide, resonators etc.

S-26.3000 Radio Engineering, special assignment for 4th year students or postgraduate students (3–8 credits), A. Räisänen, S. Tretyakov, P. Vainikainen, J. Mallat, and staff. Individual projects in connection with radio engineering research conducted in the Department of Radio Science and Engineering.

S-26.3060 Research Seminar on Radio Science and Engineering for all students but especially for 4th year and postgraduate students (1 credit), A. Räisänen and professors of the department. Weekly seminar lectures on research projects. Several visiting lectures from other research laboratories and institutes or from industry.

S-26.3120 Radio Engineering, laboratory course for 4th year students (7 credits), C. Icheln and course assistants. Microwave measurements: theory and equipment. Laboratory experiments on antenna measurements, GSM transmitter, and GSM receiver. In the spring semester design, fabrication, and measurement of a transistor amplifier.

S-26.3150 Antennas - Practice for 4th year or postgraduate students (5 credits), P. Vainikainen, C. Icheln, T. Laitinen, and J. Holopainen. Practical antenna techniques.

S-26.3161 Analytical Modelling in Radio Engineering for 4th year students or postgraduate students (4 credits), S. Tretyakov. Analytical models of thin layers, interfaces, periodical structures, and artificial materials.

S-26.4000 Postgraduate Course in Radio Science and Engineering (3-8 credits), annually varying topics. Autumn term 2011: I. Lindell: Forms, dyadics, and electromagnetic media.

S-55.1100 Basics of Electrical and Electronics Engineering for the 1st and 2nd year students (4 credits, not for electrical engineering students), K. Silvonen, L. Costa. Students learn the basics of electrical and electronics technology. Laboratory experiments.

S-55.1210 Circuit Analysis 1 for 1st year students (5 credits), M. Valtonen, A. Lehtovuori, assistants. Students learn to analyze the operation of alternating and direct current circuits and understand the basic concepts of circuit analysis.

S-55.3120 Passive Filters for 4th year students and postgraduate students (5 credits), J. Virtanen. Use of tables to design elliptical and transmission line filters from given specifications and good a command of the theory behind filter design.

S-55.3230 Circuit Simulation for 3rd year students (4–5 credits), L. Costa. Students learn the fundamental use of a circuit simulator and they understand the possibilities and limitations of the circuit simulator.

S-92.3110 Radio Science for space and environmental applications (2 credits), J. Praks. The course gives an overview on space environment, current trends in space technology, and remote sensing instruments and applications. The following application topics will be covered: environmental disaster assessment from space, climate change monitoring, interplanetary exploration, deep space missions, cosmology and radio astronomy and space research in Finland. During the course several visiting top lecturers from various space research and remote sensing institutes give general lectures about their topic.

S-92.3114 Spaceflight Instrumentation (6 credits), H. Koskinen. Design, construction and testing of space-borne instruments and their integration in satellites. Reliability analysis. Satellite orbits and spaceflights. Examples of spaceflight instrumentation projects.

S-92.3192 Special Assignment in Space Technology (5 credits), M. Hallikainen, J. Praks. An assignment on the development and use of space technology and its applications. The assignment may be a theoretical and/or experimental investigation, including a final report. The assignment may also be carried out by a group of students.

S-92.3200 Student Satellite Project (3-6 credits), J. Praks. The course consists of various assignments in the ongoing student satellite project. The aim of the project is to design and build a satellite, capable working in space environment. The project needs contributions from various engineering fields, including radio engineering, communications, electronics, mechanics, software engineering etc.

S-92.4305 Special Problems in Space Technology (5 credits), M. Tornikoski. A varying topic of current interest on space technology. This year topic was radio astronomy and the Planck satellite.

S-96.1020 History of Electrical Engineering for undergraduate and postgraduate students (3 credits), A. Sihvola. Development of electromagnetics as a science and its applications in telecommunications and power engineering up till the first part of the 20th century.

S-96.1111 Static Field Theory for 2nd year students (5 credits), A. Sihvola and course assistants. Undergraduate level basic electromagnetics course required of most Aalto ELEC students, part 1.

S-96.2180 Electromagnetic Simulations for 3rd year students (5 credits), K. Nikoskinen, H. Wallén. Introduction to two commonly used electromagnetic field simulation software packages and to the algorithms behind the programs.

S-96.3131 Electromagnetics for 3rd year students (5 credits), J. Hänninen. Solution methods for classical electromagnetic field problems.

S-96.3180 Advanced Electromagnetic Simulations for 4th year students and postgraduate students (5 credits), C. Icheln, S. Järvenpää, M. Taskinen, P. Alitalo, A. Karilainen, K. Dahlberg, and T. Zvolensky. Practical skills and knowledge of solving high frequency electromagnetic problems and designs using computer-aided software tools. The students will acquaint themselves with two software tools for computational electromagnetic simulation. A short theoretical background of each tool is taught. (1st half of course, the 2nd half given in spring 2012.)

S-96.3191 Special Project in Electromagnetics for 4th year students (3–5 credits), K. Nikoskinen, A. Sihvola. Research project on a chosen electromagnetic problem.

S-96.3320 Radiowave propagation (6 credits) for 4th year students, K. Nikoskinen, P. Vainikainen, K. Haneda, and course assistants. Radiowave propagation and scattering in different kinds of environments consisting of obstacles and interfaces.

S-96.3330 Numerical methods in electromagnetics (5 credits), P. Ylä-Oijala and a course assistant. A course for 4th year and postgraduate students with a varying topic of numerical methods in electromagnetics. In autumn 2010 semester: Introduction to the method of moments (integral equation method) for solving static or dynamic electromagnetic problems.

8. Degrees

8.1 Doctor of Science (Technology)

Ilkka Laakso	Uncertainty in computational RF dosimetry Thesis defence: 4 February 2011 Supervisor*:* Prof. Keijo Nikoskinen Opponent: Ass. Prof. Akimasa Hirata, Osaka University, Japan Preliminary examiners: Dr. Kimmo Kärkkäinen and Dr. Jafar Keshvari, Nokia Ltd.
Tommi Dufva	Solutions to electromagnetic integral equations exploiting addition theorems Thesis defence: 6 April 2011 Supervisors*:* Profs. Jukka Sarvas and Keijo Nikoskinen Opponent: Assoc. Prof. Vladimir Okhmatovski, University of Manitoba, Canada Preliminary examiners: Dr.Ignace Bogaert, Ghent University, Belgium, and Prof. Karri Muinonen, University of Helsinki

Jari Holopainen	Compact UHF-band antennas for mobile terminals: focus on modelling, implementation, and user interaction Thesis defence: 29 April 2011 Supervisor*:* Prof. Pertti Vainikainen Opponents: Prof. Dr.Ing Dirk Manteuffel, Christian-Albrechts-Universität, Kiel, Germany, and Ph.D. Kevin Boyle, EPCOS, UK Ltd, U.K. Preliminary examiners: Prof. Ph.D. Koichi Ito, Chiba University, Japan, and Ph.D. Ping Hui, Nokia Corporation, Canada
Juho Poutanen	Geometry-based radio channel modelling: Proopagation analysis and concept development Thesis defence: 13 May 2011 Supervisor*:* Prof. Pertti Vainikainen Opponent: Dr. Jonas Medbo, Ericsson Research, Sweden, and Prof. Martine Lienard, University of Lille, France Preliminary examiners: Prof. Mir Ghoraishi, Tokyo Institute of Technology, Japan, and Dr. Tricia Willink, Communication Research Centre, Canada
Johanna Leppävirta	Engineering students' proficiency in electromagnetics Thesis defence: 5 August 2011 Supervisor*:* Prof. Ari Sihvola Opponent: Prof. David Hammer, Tufts University, Medford, Massachusetts, USA Preliminary examiners: Prof. Lauri Kettunen, Tampere University of Technology, and Docent Pekka E. Hirvonen, University of Eastern Finland
Jiaran Qi	Dispersion of dielectric composites: Quasi-dynamic characterizations and applications Thesis defence: 14 September 2011 Supervisor*:* Prof. Ari Sihvola Opponent: Prof. Raj Mittra, The Pennsylvania State University, USA Preliminary examiners: Prof. Christian Mätzler, University of Bern, Switzerland, and Prof. Xudong Chen, National University of Singapore
Mark Lee Allen	Nanoparticle sintering methods and applications for printed electronics Thesis defence: 19 October 2011 Supervisor*:* Prof. Keijo Nikoskinen Opponent: Prof. Vivek Subramanian, University of California, Berkeley, USA Preliminary examiners: Prof. Hans-Erik Nilsson, Mid-Sweden University, Sweden, and Ph.D. Matti Mäntysalo, Tampere University of Technology, Finland
Suiyan Geng	Millimeter wave and UWB propagation for high throughput indoor communications Supervisor*:* Prof. Pertti Vainikainen Thesis defence: 2 November 2011 Opponent: Ph.D. Fredrik Tufvesson, Lund University, Sweden Preliminary examiners: Dr. Chia-Chin Chong, NTT Dokomo Labs, Palo Alto, CA, USA, and Prof. Hirokazu Sawada, Tohoku University, Sendai, Japan
Dmitri Chicherin	Studies on microelectromechanically tuneable high-impedance surface for millimetre wave beam steering Thesis defence: 2 December 2011 Supervisor*:* Prof. Antti Räisänen Opponent: Prof. Didier Lippens, Université des Sciences et Technologie de Lille, France Preliminary examiners: Prof. Wolfgang Menzel, University of Ulm, Germany, and Dr. Tauno Vähä-Heikkilä, VTT Technical Research Centre of Finland

Tero Kiuru

Characterization, modelling, and design for applications of waveguide impedance tuners and Schottky diodes at millmeter wave lengths
Thesis defence: 12 December 2011
Supervisor*:* Prof. Antti Räisänen
Opponent: Prof. Jan Stake, Chalmers University of Technology, Gothenburg, Sweden
Preliminary examiners: Dr Thomas Crowe, Virginia Diodes Inc., Charlottesville, VA, USA, and Dr Imran Mehdi, Jet Propulsion Laboratory, Pasadena, CA, USA

Henrik Kettunen

Complex electromagnetic responses from simple geometries
Thesis defence: 15 December 2011
Supervisor*:* Prof. Ari Sihvola
Opponent: Prof. Andrea Alù, The University of Texas, Austin, USA
Preliminary examiners: Prof. Christian Brosseau, Universitè de Bretagne Occidentale, Brest, France, and Prof. Daniel Sjöberg, Lund University, Sweden

8.2 Licentiate of Science (Technology)

Krista Dahlberg

Mixer test jig for millimeter wave Schottky diodes (Testialusta milimetri-aaltoalueen Schottky-diodeille)
Graduation date: 7 February 2011
Supervisor: Prof. Antti Räisänen
Research done at Aalto University Department of Radio Science and Engineering

Aleksi Tamminen

On developments in submillimeter-wavelength imaging (Alimillimetriaaltoalueen kuvantamismenetelmien kehittämisestä)
Graduation date: 6 October 2011
Supervisor: Prof. Antti Räisänen
Research done at Aalto University Department of Radio Science and Engineering

8.3 Diploma Engineer (M.Sc. (Tech.))

Jan Järveläinen

Operation of a direct-mode bioorganic fuel cell under the influence of an electromagnetic field (Suoramoodisen biopolttokennoakun toiminta sähkömagneettisen kentän vaikutuksen alaisena)
Graduation date: 2 May 2011
Supervisor: Prof. Pertti Vainikainen
Research done at Aalto University Department of Radio Science and Engineering

Janne Heiskanen

Metallikuorisen matkapuhelimen antennisuunnittelu (Antenna design for a metal cover mobile phone)
Graduation date: 16 June 2011
Supervisor: Prof. Antti Räisänen
Research done at Nokia Oyj

Jukka-Pekka Porko

Radio frequency interference in radio astronomy
Graduation date: 23 August 2011
Supervisor: Prof. Martti Hallikainen
Research done at Aalto University Metsähovi Radio Observatory

Henrik Kahanpää

Mars Phoenix -luotaimen paineinstrumentin testaus ja datankäsittelyalgoritmien kehitys (The Mars Phoenix pressure sensor: Tests and development of data processing procedures)
Graduation date: 5 September 2011
Supervisor: Prof. Martti Hallikainen
Research done at Finnish Meteorological Institute

Mikko Olkkonen	Power consumption optimization of a power amplifier for LTE system (Tehovahvistimen tehonkulutuksen optimointi LTE-järjestelmässä *Graduation date:* 5 September 2011 *Supervisor:* Prof. Pertti Vainikainen Research done at Aalto University Department of Radio Science and Engineering
Tommi Rimpiläinen	Anisotrooppisen pallon sähköinen vaste (Electric response of an anisotropic sphere) *Graduation date:* 5 September 2011 *Supervisor:* Prof. Ari Sihvola Research done at Aalto University Department of Radio Science and Engineering
Mikko Hulkkonen	Graphics processing unit utilization in circuit simulation (Grafiikkaprosessorin hyödyntäminen piirisimuloinnissa) *Graduation date:* 7 November 2011 *Supervisor:* Prof. Martti Valtonen Research done at Aalto University Department of Radio Science and Engineering
Joni Vehmas	Designing and measuring a novel electromagnetic transmission line-cloak for microwave frequences (Uudenlaisen sähkömagneettisen mikroaaltoverhoamislaitteen suunnittelu ja mittaus) *Graduation date:* 7 November 2011 *Supervisor:* Prof. Sergei Tretyakov Research done at Aalto University Department of Radio Science and Engineering

9. Research

9.1 Framework

RAD is the home of the Centre of Excellence in Smart Radios and Wireless Research (SMARAD) and MilliLab. SMARAD has been nominated to the status of centre-of-excellence in research by the Academy of Finland for years 2002–2007 and 2008–2013. MilliLab, the Millimetre Wave Laboratory of Finland, is a joint research institute of VTT Technical Research Centre of Finland and Aalto University. It has enjoyed the status of an External Laboratory of the European Space Agency (ESA) since 1995.

RAD has very good facilities for experimental and computational research: circuit, antenna and propagation measurement capabilities from microwaves to terahertz frequencies, a research airplane for remote sensing measurements, and access to microelectronics clean rooms (Micronova), a millimetre wave radio telescope (Metsähovi), and supercomputers (CSC).

9.2 Research activity

Information about recent research activity can be found on the Department web site at http://radio.aalto.fi/en/ . The research topics of year 2011 are portrayed in the publications below.

The Department of Radio Science and Engineering organised, in conjunction with VTT MilliLab, Millimetre Wave Days (6th ESA Workshop on Millimetre-Wave Technology and Applications and 4th Global Symposium on Millimeter Waves) from 23rd to 25th of May, 2011. Further information can be obtained from the event webpage http://gsmm2011.tkk.fi/ .

10. Publications

10.1 Books and Chapters in Books

1. L. C. Andersson, I. Hetemäki, R. Mustonen, and A. Sihvola (eds.), Kaikki irti arjesta. Helsinki: Gaudeamus University Press, 2011.
2. A. Räisänen and A. Lehto, Radiotekniikan perusteet. Helsinki: Gaudeamus Helsinki University Press, 2011.
3. A. Sihvola, Sähkömagneettisen kenttäteorian harjoituskirja, 6th edition. Helsinki: Helsinki University Press, 2011.
4. M. Valtonen and A. Lehtovuori, Piirianalyysi, Osa 1, Tasa- ja vaihtovirtapiirien analyysi. 2011.
5. I. Nefedov and S. Tretyakov, "Effective medium model for a periodic array of metallic carbon nanotubes and eigenwaves propagating in a finite-thickness carbon nanotube slab," in Physics, Chemistry and Applications of Nanostructures (V. E. Borisenko, S. V. Gaponenko, V. S. Gurin, and C. H. Kam, eds.), Singapore, World Scientific Publishing, 2011, pp. 267-269.
6. A. Sihvola, "Tieteen ja arjen numerot," in *Kaikki irti arjesta* (L. C. Andersson, I. Hetemäki, R. Mustonen, and A. Sihvola, eds.), Helsinki, 2011, pp. 294-295.
7. N. Tsitsas and C. Valagiannopoulos, "Mathematical modeling of spherical microstrip antennas and applications," in InTech Microstrip Antennas Book, Open source e-book, 2011, p. 22.

10.2 Refereed Journal Articles

1. M. Albooyeh, D. Morits, and C. Simovski, "Electromagnetic characterization of substrated metasurfaces," Metamaterials, vol. 5, no. 3, pp. 93-111, 2011.
2. P. Alitalo, A. O. Karilainen, T. Niemi, C. R. Simovski, and S. A. Tretyakov, "Design and realisation of an electrically small Huygens source for circular polarization," IET Microwaves, Antennas & Propagation, vol. 5, no. 7, pp. 783-789, 2011.
3. P. Alitalo and S. Tretyakov, "Broadband electromagnetic cloaking realized with transmission-line and waveguiding structures (invited paper)," Proceedings of the IEEE, vol. 99, no. 10, pp. 1646-1659, 2011.
4. L. Bergamin, P. Alitalo, and S. Tretyakov, "Nonlinear transformation optics and engineering of the Kerr effect," Physical Review B, vol. 84, no. 20, p. 205103 8, 2011.
5. L. Bergamin and A. Favaro, "The non-birefringent limit of all linear, skewonless media and its unique light-cone structure," Annalen der Physik, vol. 523, no. 5, pp. 383-401, 2011.
6. A. Bin Abdullah Al-Hadi, J. Ilvonen, R. Valkonen, J. Holopainen, O. Kivekäs, C. Icheln, and P. Vainikainen, "Coupling element –based dual-antenna structures with hand effects," International Journal of Wireless Information Networks, vol. 18, no. 3, pp. 146-157, 2011.
7. A. Bin Abdullah Al-Hadi, V. Papamichael, and P. Vainikainen, "Multi-antenna mobile terminal diversity performance in proximity to human hands under different propagation environment conditions," Electronics Letters, vol. 47, pp. 1214-1215, 2011.
8. D. Chicherin, M. Sterner, D. Lioubtchenko, J. Oberhammer, and A. V. Räisänen, "Analog-type millimeter-wave phase shifters based on MEMS tunable high-impedance surface and dielectric rod waveguide," International Journal of Microwave and Wireless Technologies, vol. 3, no. 5, pp. 533-538, 2011.
9. F. Costa, O. Luukkonen, C. Simovski, A. Monorchio, S. Tretyakov, and P. de Maagt, "TE surface wave resonances on high-impedance surface based antennas: Analysis and modeling," IEEE Transactions on Antennas and Propagation, vol. 59, no. 10, pp. 3588-3596, 2011.
10. M.-C. Gosselin, G. Vermeeren, S. Kuhn, V. Kellerman, S. Benkler, T. Uusitupa, W. Joseph, A. Gati, J. Wiart, F. Meyer, L. Martens, T. Nojima, T. Hikage, Q. Balzano, A. Christ, and N.Kuster, "Estimation formulas for the specific absorption rate in humans exposed to base-station antennas," IEEE Transactions on Electromagnetic Compatibility, vol. 53, no.4, pp. 909-922, 2011.
11. M. Hallikainen, "Remote sensing activities in Finland 2011," EARSeL Newsletter, no. 88, pp. 17-19, 2011.
12. J. Holopainen, O. Kivekäs, J. Ilvonen, R. Valkonen, C. Icheln, and P. Vainikainen, "Effect of the user's hands on the operation of lower UHF-band mobile terminal antennas: Focus on digital television receiver," IEEE Transactions on Electromagnetic Compatibility, vol. 53, no. 3, pp. 831-841, 2011.
13. J. Ilvonen, O. Kivekäs, J. Holopainen, R. Valkonen, K. Rasilainen, and P. Vainikainen, "Mobile terminal antenna performance with the user's hand: Effect of antenna dimensioning and location," IEEE Antennas and Wireless Propagation Letters, vol. 10, pp. 772-775, 2011.

14. J. Ilvonen, R. Valkonen, O. Kivekäs, P. Li, and P. Vainikainen, “Antenna shielding method reducing the interaction between user and mobile terminal antenna,” Electronics Letters, vol. 47, no. 16, pp. 896-897, 2011.
15. J. Kainulainen, K. Rautiainen, J. Lemmetyinen, M. T. Hallikainen, F. Martín-Porqueras, and M. Martín-Neira, “Detection of a sea surface salinity gradient using data sets of airborne synthetic aperture radiometer HUT-2-d and a GNSS-r instrument,” IEEE Transactions on Geoscience and Remote Sensing, vol. 49, no. 11, pp. 4561-4571, 2011.
16. J. Kainulainen, K. Rautiainen, J. Lemmetyinen, J. Seppänen, P. Sievinen, M. Takala, and M. Hallikainen, “Experimental study on radiometric performance of synthetic aperture radiometer HUT-2D – measurements of natural targets,” IEEE Transactions on Geoscience and Remote Sensing, vol. 49, no. 2, pp. 814-826, 2011.
17. A. O. Karilainen, P. M. T. Ikonen, C. R. Simovski, S. A. Tretyakov, A. N. Lagarkov, S. A. Maklakov, K. N. Rozanov, and S. N. Starostenko, “Experimental studies on antenna miniaturisation using magneto-dielectric and dielectric materials,” IET Microwaves, Antennas & Propagation, vol. 5, no. 4, pp. 495-502, 2011.
18. A. O. Karilainen, P. M. T. Ikonen, C. R. Simovski, and S. A. Tretyakov, “Choosing dielectric or magnetic material to optimize the bandwidth of miniaturized resonant antennas,” IEEE Transactions on Antennas and Propagation, vol. 59, no. 11, pp. 3991-3998, 2011.
19. A. O. Karilainen, J. Vehmas, O. Luukkonen, and S. A. Tretyakov, “High-impedance-surface-based antenna with two orthogonal radiating modes,” IEEE Antennas and Wireless Propagation Letters, vol. 10, pp. 247-250, 2011.
20. H. Kettunen, J. Qi, H. Wallén, and A. Sihvola, “Homogenization of thin dielectric composite slabs: techniques and limitations,” Applied Computational Electromagnetics Society Journal, vol. 26, no. 3, pp. 179-187, 2011.
21. T. Kiuru, J. Mallat, A. V. Räisänen, and T. Närhi, “Schottky diode series resistance and thermal resistance extraction from s-parameter and temperature controlled i–v measurements,” IEEE Transactions on Microwave Theory and Techniques, vol. 59, no. 8, p. 2116, 2011.
22. O. N. Kozina, L. A. Melnikov, and I. S. Nefedov, “Strong field localization in subwavelength metal-dielectric optical waveguides,” Optics and Spectroscopy, vol. 111, no. 2, pp. 241-247, 2011.
23. O. Kozina, I. Nefedov, L. Melnikov, and A. Karilainen, “Plasmonic coaxial waveguides with complex shapes of cross-sections,” Materials, vol. 4, no. 1, pp. 104-116, 2011.
24. M. Kyrö, K. Haneda, J. Simola, K. Nakai, K.-i. Takizawa, H. Hagiwara, and P. Vainikainen, “Measurement based path loss and delay spread modeling in hospital environments at 60 GHz,” IEEE Transactions on Wireless Communications, vol. 10, no. 8, pp. 2423-2427, 2011.
25. I. Laakso and T. Uusitupa, “Edge- or face-based electric field in FDTD: Implications for dosimetry,” The Radio Science Bulletin, no. 337, pp. 12-18, 2011.
26. J. Leppävirta, H. Kettunen, and A. Sihvola, “Complex problem exercises in developing engineering students' conceptual and procedural knowledge of electromagnetics,” IEEE Transactions on Education, vol. 54, no. 1, pp. 63-66, 2011.
27. J. Leppävirta, “The impact of mathematics anxiety on the performance of students of electromagnetics,” Journal of Engineering Education, vol. 100, no. 3, pp. 424-443, 2011.
28. I. Liberal, I. S. Nefedov, I. Ederra, R. Gonzalo, and S. A. Tretyakov, “Electromagnetic response and homogenization of grids of ferromagnetic microwires,” Journal of Applied Physics, vol. 110, no. 6, p. 064909 8, 2011.
29. I. Liberal, I. Nefedov, I. Ederra, R. Gonzalo, and S. Tretyakov, “On the effective permittivity of arrays of ferromagnetic wires,” Journal of Applied Physics, vol. 110, no. 10, p. 104902 8, 2011.
30. I. V. Lindell, L. Bergamin, and A. Favaro, “The class of electromagnetic P-media and its generalization,” Progress in Electromagnetic Research B, vol. 28, pp. 143-162, 2011.
31. I. V. Lindell, J. Markkanen, A. Sihvola, and P. Ylä-Oijala, “Realization of spherical D'B' boundary by a layer of wave-guiding medium,” Metamaterials, vol. 5, no. 4, pp. 149-154, 2011.
32. I. V. Lindell, A. Sihvola, L. Bergamin, and A. Favaro, “Realization of the D'B' boundary condition,” IEEE Antennas and Wireless Propagation Letters, vol. 10, pp. 643-646, 2011.
33. O. Luukkonen, S. I. Maslovski, and S. A. Tretyakov, “A stepwise Nicolson-Ross-Weir -based material parameter extraction method,” IEEE Antennas and Wireless Propagation Letters, vol. 10, pp. 1295-1298, 2011.
34. J. Markkanen, P. Ylä-Oijala, and A. Sihvola, “Surface integral equation method for scattering by DB objects with sharp wedges,” Applied Computational Electromagnetics Society Journal, vol. 26, no. 5, pp. 367-374, 2011.

35. J. Markkanen, P. Ylä-Oijala, and A. Sihvola, “Computation of scattering by DB objects with surface integral equation method,” IEEE Transactions on Antennas and Propagation, vol. 59, no. 1, pp. 154-161, 2011.
36. P. Miettinen, M. Honkala, J. Roos, and M. Valtonen, “PartMOR: Partitioning-based realizable model-order reduction method for RLC circuits,” IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, vol. 30, no. 3, pp. 374-387, 2011.
37. A. Miroshnichenko, I. Maksymov, A. Davoyan, C. Simovski, P. Belov, and Y. Kivshar, “An arrayed nanoantenna for broadband light emission and detection,” Physica Status Solidi - Rapid Research. Letters, vol. 5, no. 9, pp. 347-349, 2011.
38. S. Myllymäki, R. Valkonen, J. Holopainen, A. Huttunen, V. K. Palukuru, M. Berg, H. Jantunen, and E. Salonen, “Capacitive-sensor-induced losses in 900-, 1800-, and 1900-MHz antennas,” IEEE Antennas and Wireless Propagation Letters, vol. 10, pp. 330-333, 2011.
39. I. S. Nefedov and S. A. Tretyakov, “Ultrabroadband electromagnetically indefinite medium formed by aligned carbon nanotubes,” Physical Review B, vol. 84, no. 11, p. 113410 4, 2011.
40. I. S. Nefedov and S. A. Tretyakov, “Effective medium model for two-dimensional periodic arrays of carbon nanotubes,” Photonics and Nanostructures - Fundamentals and Applications, vol. 9, no. 4, pp. 374-380, 2011.
41. I. Nefedov and C. Simovski, “Giant radiation heat transfer through micron gaps,” Physical Review B, vol. 84, no. 19, p. 195459 8, 2011.
42. P. Padilla, J. P. Pousi, A. Tamminen, J. Mallat, J. Ala-Laurinaho, M. Sierra-Castaner, and A. V. Räisänen, “Experimental determination of DRW antenna phase center at mm-wavelengths using a planar scanner: comparison of different methods,” IEEE Transactions on Antennas and Propagation, vol. 59, no. 8, pp. 2806-2812, 2011.
43. J. Poutanen, J. Salmi, K. Haneda, V.-M. Kolmonen, and P. Vainikainen, “Angular and shadowing characteristics of dense multipath components in indoor radio channels,” IEEE Transactions on Antennas and Propagation, pp. 245-253, 2011.
44. J. Qi, H. Kettunen, H. Wallén, and A. Sihvola, “Different homogenization methods based on scattering parameters of dielectric-composite slabs,” Radio Science, vol. 46, no. RS0E08, p. 8 (doi:10.1029/2010RS004622), 2011.
45. J. Qi and A. Sihvola, “Dispersion of the dielectric Frohlich model and mixtures,” IEEE Transactions on Dielectrics and Electrical Insulation, vol. 18, no. 1, pp. 149-154, 2011.
46. C. Schmidt, T. Laitinen, and T. Eibert, “Hybrid fast Fourier transform-plane wave based near-field far-field transformation for “body of revolution” antenna measurement grids,” Radio Science, vol. 46, no. RS0E15, p. 9, 2011.
47. C. Simovski and M. Albooyeh, “Substrate-induced bianisotropy in plasmonic grids,” Journal of Optics, vol. 13, no. 10, p. 105102, 2011.
48. C. Simovski and D. Morits, “Isotropic negative effective permeability in the visible range produced by clusters of plasmonic triangular nanoprisms,” Metamaterials, vol. 5, no. 4, pp. 162-168, 2011.
49. C. Simovski, “On electromagnetic characterization and homogenization of nanostructured metamaterials,” Journal of Optics, vol. 13, no. 1, p. 013001, 2011.
50. M. Sterner, N. Somjit, U. Shah, S. Dudorov, D. Chicherin, A. V. Räisänen, and J. Oberhammer, “Microwave MEMS devices designed for process robustness and operational reliability,” International Journal of Microwave and Wireless Technologies, vol. 3, no. 5, pp. 547-563, 2011.
51. S. Steshenko, F. Capolino, P. Alitalo, and S. Tretyakov, “Effective model and investigation of the near-field enhancement and subwavelength imaging properties of multilayer arrays of plasmonic nanospheres,” Physical Review E, vol. 84, no. 1, p. 016607, 2011.
52. J. Toivanen, T. Laitinen, V.-M. Kolmonen, and P. Vainikainen, “Reproduction of arbitrary radio-channel environment,” IEEE Transactions on Instrumentation and Measurement, vol. 60, no. 1, pp. 275-281, 2011.
53. S. Tretyakov, “Bianisotropic materials optimized for strong interactions with electromagnetic fields,” Problems of Physics, Mathematics, and Technics (Special issue on the occasion of the centenary of F.I. Fedorov, invited paper), vol. 2, no. 7, pp. 49-51, 2011.
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